

Technician Licensing Class

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Special thanks to K3DIO

The Plano Amateur Radio Klub (TX)

Much of this material is from them



Electronic Fundamentals

- Sub-agenda goes here

Types of Electricity

- Direct Current (DC)
 - Electrons flow from negative to positive
 - E.G. Batteries
 - Subject to voltage loss over distance
 - All electronics use DC internally
- Alternating Current (AC)
 - Electrons alternate (cycle) directions
 - E.G. House 110V
 - Less prone to voltage loss

Electricity Terms

- Voltage (V)
 - How much “energy potential” there is
 - Similar to the height of a river
 - Measured in “volts”
- Current (I)
 - How much is flowing
 - Similar to the size of a river
 - Measured in Amps

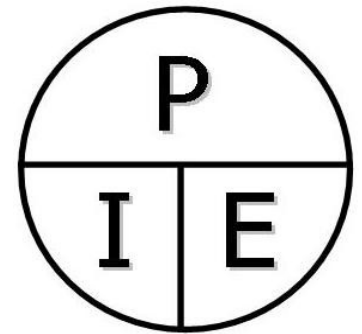
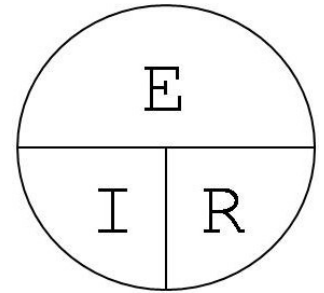
Power and Resistance

- Power measures the energy
 - How much current is flowing
 - How many volts
 - $P = I * V$
 - Measured in “Watts”
- Resistance
 - Measures how “restricted” electricity is from flowing through an object
 - Measured in “Ohms”
 - Similar to thin vs fat water pipes
 - $V = I * R$ (Ohms Law)

Easy to Remember Helpers

- Volts/EMF:
 - Some use 'E' some use 'V'
- $E = I * R$

- $P = I * E$
 - $P = I * I * R$
 - $P = E * E / R$



Measuring Electricity

Multimeters will measure Voltage, Current and Resistance.

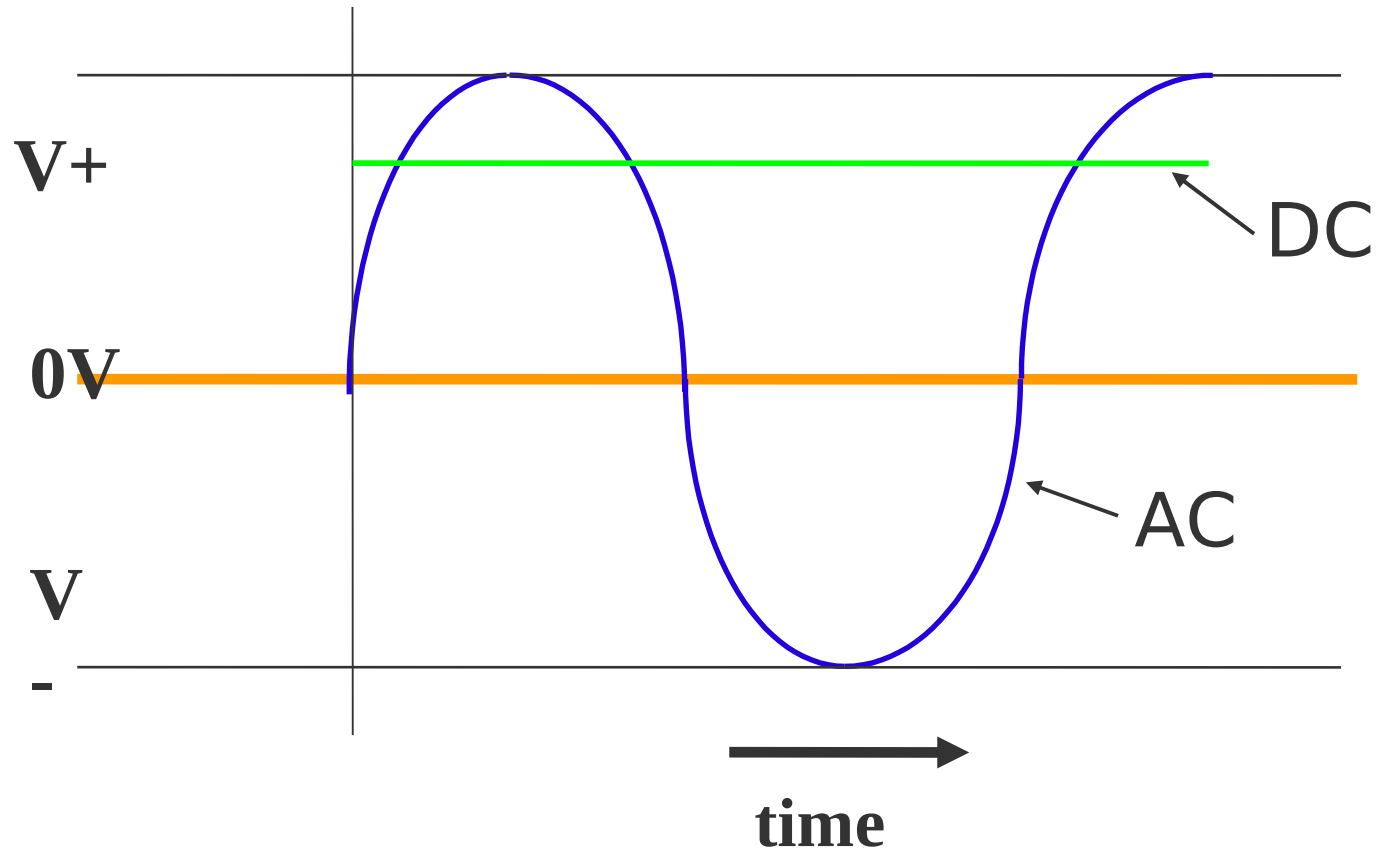
Be sure it is set properly to read what is being measured.

If it is set to the ohms setting and voltage is measured the meter could be damaged!



- Volt meter: measures volts
“electromotive force” (EMF)
- Ammeter: measures current
- Potentiometer: measures resistance

AC vs DC



Amplitude: the “peak” of the high and low cycles

Measuring Electricity

- DC
 - Is measured as a linear value
 - It doesn't change, so it's easy
- AC
 - The voltage/current constantly rise and fall
 - Measured by average amplitude
 - How fast it alternates is measured in time
 - “Hertz”: How many cycles per second

Sources of Power

- Power stations
 - Deliver AC power at 110V or 220V
- Batteries
 - Standard batteries: ~1.5V
 - Car batteries: ~12V
- Generators
- Solar cells
- Wind
- ...

Equipment

A **Power Supply** is the device used to convert the alternating current from a wall outlet into low-voltage direct current.



An **Amplifier** is a device used to increase the output of a 10 watt radio to 100 watts.



Battery Care

- In order to keep rechargeable batteries in good condition and ready for emergencies:
 - They must be inspected for physical damage and replaced if necessary
 - They should be stored in a cool and dry location
 - They must be given a maintenance recharge at least every 6 months
- The best way to get the most amount of energy from a battery is to draw current from the battery at the slowest rate needed.

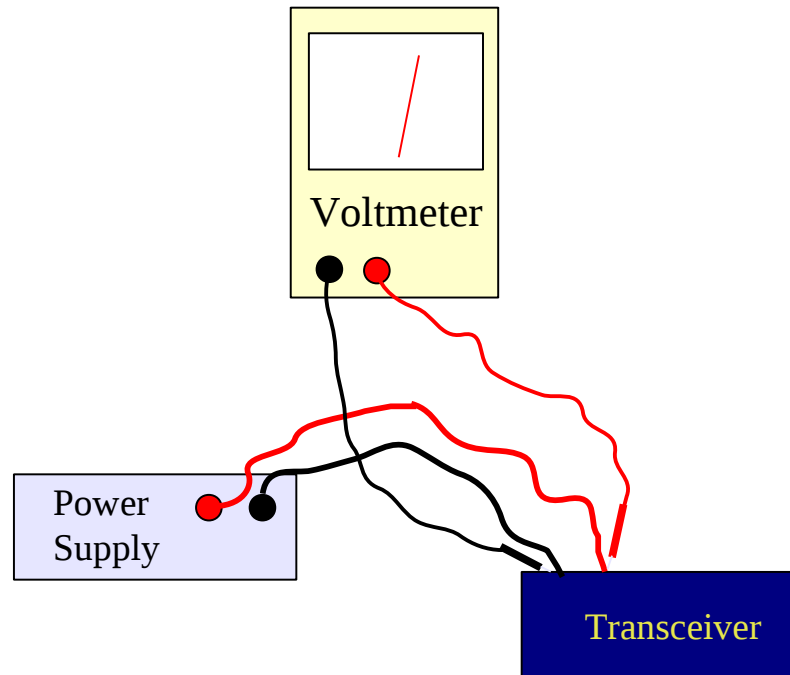
Conductors and Insulators

- Conductors:
 - Very Low resistance (near 0)
 - Most metals (copper, gold!, aluminum)
- Insulators:
 - Very high resistance (near infinity)
 - Glass, ceramics, plastic, rubber



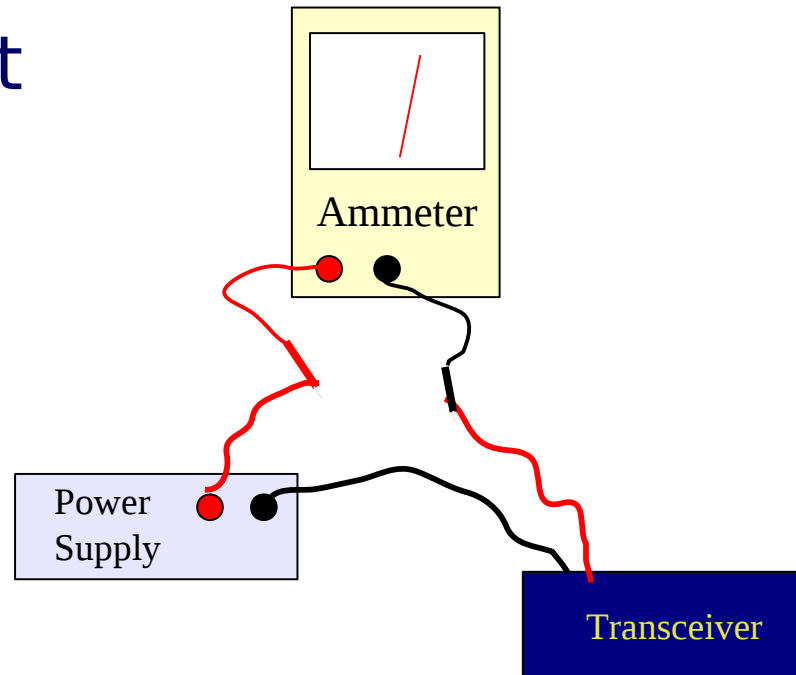
Measuring Voltage

- Measured between two points
 - Can be done without changing the circuit



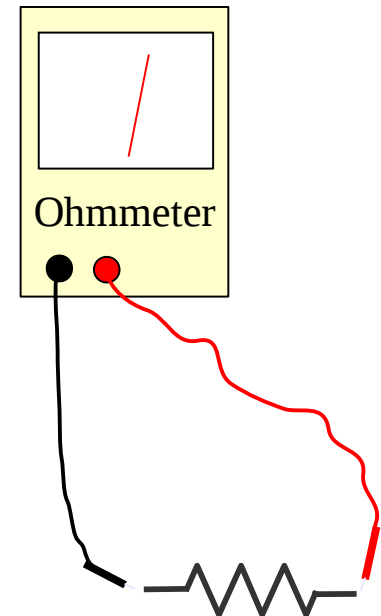
Measuring Current

- To measure current you **MUST** interrupt the circuit to put the meter between two points
 - It becomes part of the circuit



Measuring Resistance

- Measures across the resistor
 - Puts voltage across it
 - Measures the current

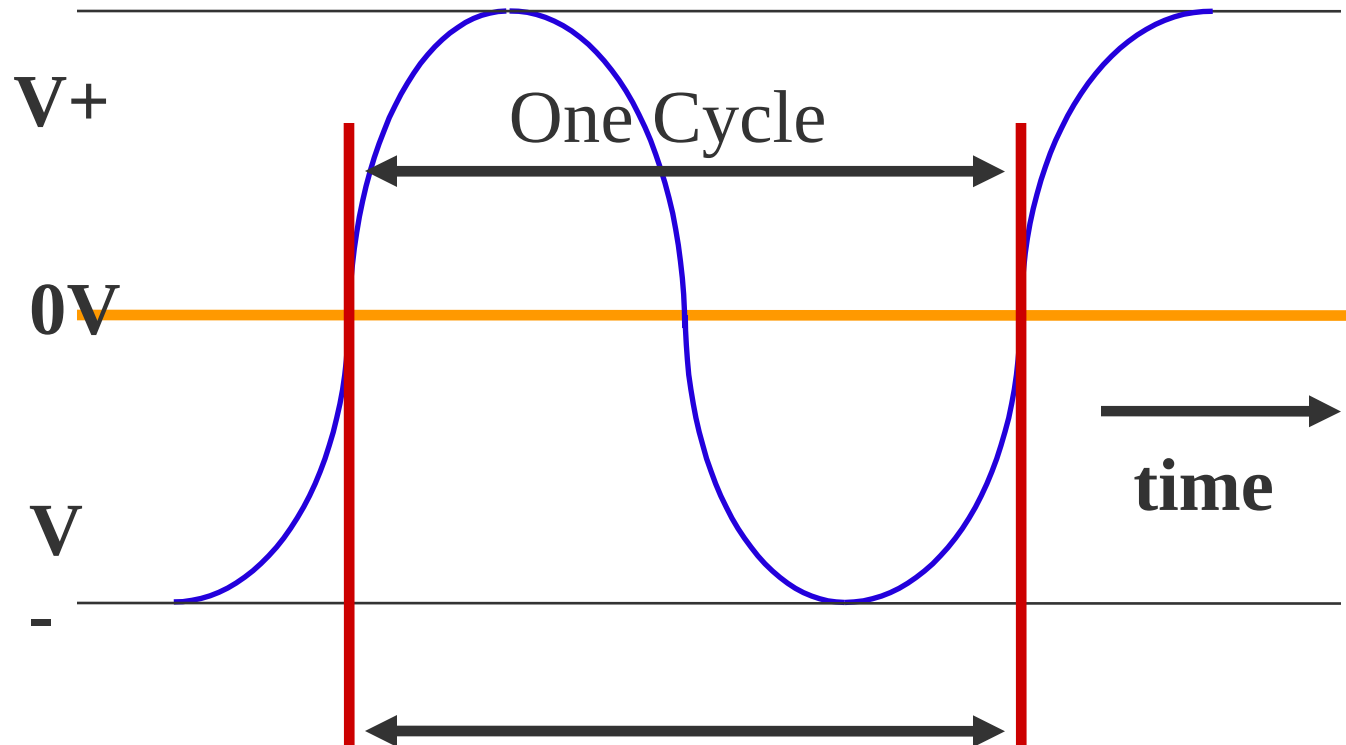


Alternating Electricity

- Frequency: How fast something cycles
 - Electricity
 - Radio waves
 - Water waves!
- Hertz: cycles per second
- House AC: 60 Herz
 - Up and down 60 times in one second
- Wavelength:
 - Distance a radio wave travels in one cycle

Wavelength and Frequency

The distance a radio wave travels in one cycle is called wavelength.



Radio “Wave” Properties

- As frequency increases
 - Wavelength gets shorter
- Equations
 - Frequency (MHz) = $300 / \text{wavelength (m)}$
 - Wavelength (m) = $300 / \text{frequency (MHz)}$
 - $F = 300/S$
- Speed
 - Light is a type of radio wave
 - Radio waves travel at the speed of light
 - (fastest in a vacuum)
 - Radio waves are waves greater than 20k Hz

Unit Prefixes

Prefix	Meaning
G (giga)	1,000,000,000
M (mega)	1,000,000
k (Kilo)	1,000
m (milli)	1/1000
u (micro)	1/1,000,000
n (nano)	1/1,000,000,000
p (pico)	1/1,000,000,000,000

Examples:

1 MHz = 1,000,000 Hertz

1 k Ohm = 1000 Ohms

1 kV = 1000 Volts

1 mA = 1/1000 of 1 Amp

Ham Radio Bands

- Are identified by both frequency and wavelength
 - 2m band 147 MHz
 - Bottom: 144 MHz = 2.083333 m
 - Top: 148 MHz = 2.027027 m
 - 5m band 50 MHz
 - 160m band 1.875 MHz
- Note the inverse relationship!
 - One goes up, the other goes down
 - Guess what's gonna happen to antenna sizes!

Sound Waves

- Sound Waves
 - You hear air being pushed back and forth
 - Atoms bump against each other
 - Causes vibrations in your ear
 - Guess what: the waves have a frequency
- Human hearing: 300 Hz – 3000 Hz
- Electronics convert signals to sound
 - E.G. Receivers: receive radio waves, convert to electricity, and then speakers convert to sound waves

Questions?

